Carbon Sequestration:
Opportunities for Methane Digesters in the Carbon Markets

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Presentation Overview

- Overview
- Roles and Responsibilities
- Anaerobic Digester Eligibility
- Contracting
- Verification
- Trading
- Payments

Overview

- **Farmers/landowners earn greenhouse gas emissions credits** when they use conservation tillage, plant grasses and trees, or capture methane with manure digesters.
- **Conservation practices** store carbon in the soil and plants. Manure digesters produce energy and prevent methane from being released to the atmosphere.
- **Credits are aggregated** from many landowners and sold through the Chicago Climate Exchange (CCX®).

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About the Chicago Climate Exchange

- Voluntary, legally binding.
- Cap and trade. Members reduce emissions and/or buy credits
- Members include: Ford Motor Company, City of Chicago, Waste Management.
- Reduce GHG emissions 4% between 2003 and 2005 and an additional 2% between 2006 and 2010. Members joining after 2005 agree to reduce GHG emissions by 6% between 2006 and 2010.
- Since its inception in 2003, 19,160,680 metric tons of CO_2 reduced - 8% overall reduction.

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About the Delta Institute

The Delta Institute is a Chicago-based non-profit organization promoting environmental quality and community development in the Great Lakes region

- **Aggregator** for carbon offset credits.
- **Trade credits** on the CCX® platform
- **Reimburse** project owners
- **Program reporting** to the Advisory Committee and CCX®

Eligibility

- Project owners may directly register with CCX® if the project yields more than 10,000 metric tons of CO_2 per year.
- **Methane projects** implemented after January 1, 1999 with necessary biogas flow or electric output monitoring equipment:
  - 18.25 metric tons CO_2 per ton of methane per year.
- No minimum contract for methane offsets (XMOs).

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Eligibility

- Standards of practice found in the U.S. EPA National Resource Conservation Service for Anaerobic Digesters.
- Demonstrate clear ownership rights of the project owner to the greenhouse gas emissions registered with CCX®.
- Demonstrate eligibility of the site to earn XMOs.
- Keep and maintain records of methane content and total gas flows or total electricity generated from the project.

Contracting

- Contract is between the Delta Institute (CCX approved aggregator) and the project owner.
- Separate contracts for Methane Offset Credit- XMO- projects.
- Contracts stipulate the program requirements and give the Delta Institute the right to trade the carbon offset credits.
- There are no minimum contract periods for Methane Offset projects.

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Verification- Methane Digesters

- The third party verifier will visit each project location to verify that the proper equipment is installed.
- Carbon offsets can be traded after the verification report is received and accepted.
- Verification can occur any time of the year and usually occurs more than once per year.
- The first year verification includes a site visit. Subsequent verifications may not require a site visit unless there has been equipment changes.

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Trading

- As an aggregator, the Delta Institute can trade carbon offset credits on the CCX® platform.
- Carbon offsets can only be traded once verification has occurred and has been accepted by CCX®.
- 80% of the credits can be traded- 20% is required to remain in an off-set pool owned by the project owner that is sold at the end of the contract period.
- Trades are conducted in blocks of 100 metric ton units.
- On December 4, 2006, carbon was trading at approximately $4.25 per metric ton according to the vintage year.

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Payments

- Once carbon offsets are traded, the funds from the trade will be placed by CCX® in an account maintained by the Delta Institute.
- CCX® trading fees will be deducted from the proceeds from the trade on a per metric ton CO_2 basis. $0.14/meteric ton of CO_2 traded.
- An aggregation fee of 8% will also be deducted from the gross proceeds.
- The Delta Institute will provide payments to the project owners based on metric tons of carbon traded.

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Methane Digester Example

An anaerobic digester combusts 20,000,000 cubic feet (approximately 1,000 head dairy) of biogas per year (60% methane, 40% CO_2 mix). Equivalent to approximately 4,130 metric tons of CO_2.

Value of carbon offsets = 4,130 x $4.00	***$16,520***
CCX Trading Fee = 4,130 x $0.14	*$578*
Aggregator Fee = $16,520 x 8%	*$1,322*
Verification (Year 1)- Approximate	*$3,000*
Verification (Year 2)- Approximate	*$1,500*
TOTAL Fees (Year 1)	***$4,900***
Payment to Project Owner (Year 1)	$11,620
Payment to Project Owner (Year 2)	$13,120

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Example Digester Carbon Paybacks

Farm Type	Herd Size	Manure Waste Generated (gpd)	Electric Generation (kW/yr)	Estimated Biogas Generation (cf/yr)	Estimated Methane Produced (metric tons/year)	Potential Carbon (metric tons/year)	Potential First Year Revenue from Sale of Carbon Credits ($)
Dairy	1100	30,000	1,600,000	21,900,000	199	3,631	**$9,854**
Dairy	725	35,000	876,051	25,550,000	232	4,236	**$11,996**
Dairy	840	22,000	1,095,000	18,834,000	171	3,123	**$8,054**
Dairy	3750	115,000	NA	83,950,000	763	13,919	**$46,274**
Dairy	1400	38,000	1,500,000	17,383,333	158	2,882	**$7,203**
Dairy	1000	20,000	NA	14,600,000	133	2,421	**$5,569**
Dairy	2400	50,000	NA	43,800,000	398	7,262	**$22,708**
Dairy	700	17,000	NA	12,410,000	113	2,058	**$4,284**
Swine	2300	NA	NA	7,884,000	72	1,307	**$1,627**

Price of carbon based on recent market value of $4.00 per metric ton

Carbon generated is methane produced multiplied by 18.25 tons CO2 per ton of methane

= Estimate based on gpd of manure

Methane generation ranges from 82 to 102 CF/Cow/Day

Electrical generation range from 1071 Kwh/Cow/yr

Methane generation ranges from 2 to 4 CF/gallon of manure

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Background Calculations

[CH_4 recovered (standard ft^3/hour)] = [average biogas recovery rate (standard ft^3/hour)]x [average hourly $\%CH_4$].

Methane recovery (ft^3) = [kWhr of electricity produced from the biogas fuel] x [heat rate in Btu/kWhr] / [1012 Btu/ft^3 (HHV of methane)]

CH_4 combusted (Mg/yr) = [CH_4 recovery (ft^3/yr)] x [16 (molecular weight of CH_4)] x [1Mg/10^6 g]* [1mol/24.04L @ STP] x [28.32L/1cf]

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